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A new species of *Simulium* (*Simulium*) from Luzon Island, the Philippines (Diptera: Simuliidae)

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Abstract: The female, male and pupa of *Simulium* (*Simulium*) *banahauense* sp. nov. are described on the basis of the specimens collected from Quezon Province, Luzon Island, the Philippines. This new species belongs to the *melanopus* species-group and is easily distinguished from all the known species by the bare aedeagal membrane of the male genitalia, as well as the dark fore coxae.

Key words: *Simulium*, black fly, Simuliidae, Luzon, Philippines, description

The *melanopus* species-group of the subgenus *Simulium* (*Simulium*) Latreille s. str. originally defined by Takaoka (1983) and redefined by Takaoka (2003), consisted of 32 species recorded from the Philippines, Indonesia and Malaysia (Crosskey and Howard, 2004; Takaoka, 1983, 2001a,b, 2003; Takaoka and Davies, 1995, 1996). Recently, seven new species of the same species-group were described from northern parts of Luzon Island, the Philippines (Takaoka, 2006a,b).

This paper describes one more new species of the *melanopus* species-group based on the specimens collected from Quezon Province of Luzon Island. This new species is distinctive in having the bare aedeagal membrane of the male genitalia within the *melanopus* species-group.

The terms for morphological features used here follow those of Takaoka (2003). Holotype and paratype specimens of the new species are deposited at the Department of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

Simulium (*Simulium*) *banahauense* sp. nov.

DESCRIPTION. **Female.** Body length 2.0–

2.5 mm. **Head.** Narrower than width of thorax. Frons brownish-black, shiny, with several dark stout hairs along lateral margins; frontal ratio 1.31 : 1.00 : 1.12; frons-head ratio 1.0 : 3.6. Fronto-ocular area (Fig. 1A) shallow, triangular or rounded laterally. Clypeus brownish-black, shiny, whitish-gray pruinose, moderately covered with dark stout hairs except upper portion bare; clypeus silvery iridescent when illuminated at certain angle of light. Labrum 0.5 times as long as clypeus. Antenna composed of scape, pedicel and 9 flagellomeres, medium brown except scape, pedicel and most of 1st flagellomere yellow. Maxillary palp medium brown, composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.00 : 1.34 : 2.47; 3rd segment (Fig. 2B, C) slightly enlarged; sensory vesicle (Fig. 2B, C) small, ellipsoidal, 0.22 times as long as 3rd segment, with medium-sized round opening medially or near apex. Maxillary lacinia with 10 or 11 inner and 11 or 12 outer teeth. Mandible with 27 inner and 12 outer teeth. Cibarium (Fig. 2D) with about 76 minute tubercles. **Thorax.** Scutum dark brown to brownish-black, shiny, thinly whitish-gray pruinose, moderately covered with light to medium brown recumbent short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum dark brown, shiny, with dark brown long upright hairs. Postnotum dark brown, shiny, whitish-gray pruinose when viewed at certain

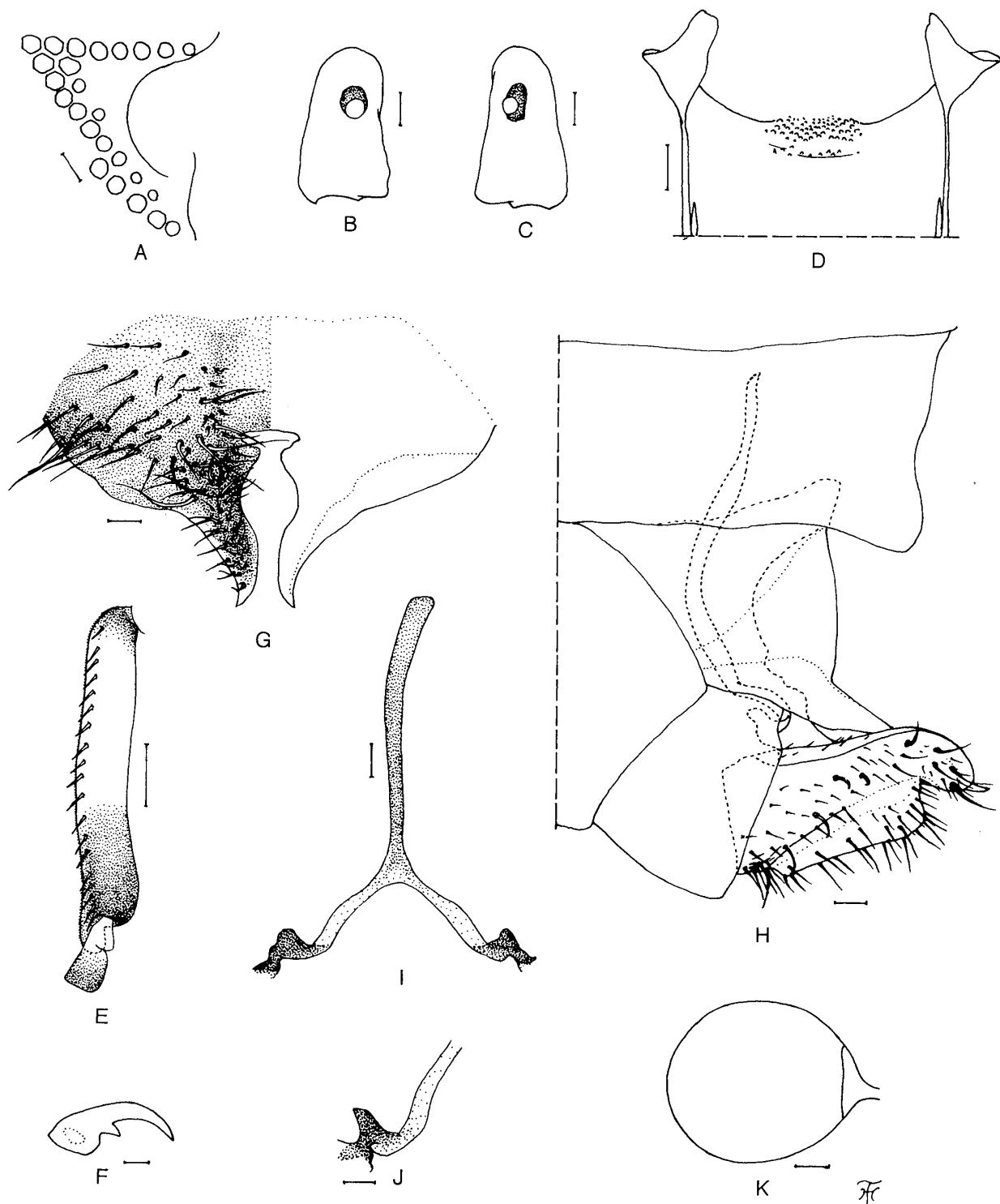


Fig. 1. Female of *Simulium (Simulium) banahauense* sp. nov. A, fronto-ocular area (right side); B and C, 3rd segments of maxillary palp with sensory vesicle (front view); D, cibarium; E, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side, outer view); F, claw; G, 8th sternite and ovipositor valves *in situ* (ventral view); H, posterior tip of abdomen showing 8th sternite, genital fork, paraproct and cercus *in situ* (lateral view); I, genital fork (ventral view); J, arm of genital fork (right side; ventral view); K, spermatheca. Scale bars. 0.1 mm for E; 0.02 mm for A-D and G-K; 0.01 mm for F.

angle of light and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, bare, shiny when illuminated. **Legs.** Medium brown to brownish-black except basal 2/3 of mid basitarsus, basal 2/3 of hind basitarsus (though base dark), and basal 1/2 of 2nd hind tarsal segment yellowish-white. Fore tibia with whitish-gray (iridescent at certain angle of light) sheen on outer surface when illuminated, mid and hind tibiae with similar sheen on posterior surface; fore tarsus with thick dorsal crest of short hairs; fore basitarsus greatly dilated, 4.4 times as long as its greatest width; hind basitarsus (Fig. 1E) nearly parallel-sided, 5.71 times as long as its greatest width, 0.67 and 0.56 times as wide as greatest widths of hind tibia and femur, respectively; calcipala 1.1 times as long as width at base, and 0.45 times as wide as width of basitarsus; pedisulcus distinct; claw (Fig. 1F) with small subbasal tooth. **Wing.** Length 1.7–2.0 mm. Costa with spinules and hairs. Subcosta haired except near apex bare. Basal section of vein R bare (though 1 female had 1 hair on that of left wing); R₁ with spinules and hairs; R₂ with hairs only. Hairs at base of stem vein dark brown. Basal cell absent. **Abdomen.** Basal scale medium brown, with fringe of long hairs. Dorsal surface of abdominal segments medium brown to brownish-black, with dark hairs; 2nd segment with pair of large whitish iridescent dorsolateral spots broadly connected to each other medially; tergites 5–9 shiny. Ventral surface of abdominal segment 7 without sternal plate. **Genitalia.** Sternite 8 (Fig. 1G) well sclerotized, moderately depressed medially, sparsely or moderately covered with long stout and medium-long fine hairs on each side, with posterior margin much produced posteriorly forming elongate lobes which are not well demarcated from ovipositor valves; these lobes (fused with ovipositor valve) tapered posteriorly with transparent bare pointed apex, moderately bent ventrally (elongate lobes against sternite 8 on ventral side at about 120 degrees when viewed laterally—Fig. 1H), and covered with numerous short to long hairs on ventral surface; inner margins of elongate lobes well sclerotized, moderately concave subbasally, moderately separated from each other. Genital fork (Fig. 1I, J) of inverted-Y form; stem slender and well sclerotized; arms slender, each with strongly-sclerotized angulate lateral ridge having short to medium-long stout projection

directed anterodorsally. Paraproct in lateral view (Fig. 1H) much produced ventroposteriorly, 2.3 times as wide as its basal length, covered with several long stout hairs and numerous short fine hairs on lateral surface; paraproct anteroventrally with thin elongate moderately-sclerotized plate having round apical tip and several short setae scattered on its surface. Cercus in lateral view (Fig. 1H) very short, with posterior margin nearly straight, about 3.9 times as wide as its greatest length, and covered with numerous hairs. Spermatheca (Fig. 1K) nearly globular, well sclerotized except duct and wide area of juncure to duct unsclerotized, without reticulate surface patterns; minute internal setae present; both accessory ducts subequal in diameter to each other, and also to that of main duct.

Male. Body length 2.6–2.9 mm. **Head.** Slightly wider than thorax. Upper eye consisting of large facets in 17 vertical columns and in 17 horizontal rows. Clypeus dark brown, whitish-gray pruinose, silvery iridescent when illuminated, moderately covered with dark brown long hairs though narrow median portion bare longitudinally. Antenna composed of scape, pedicel and 9 flagellomeres, medium brown except scape, pedicel, and base of 1st flagellomere yellow; 1st flagellomere elongate, 1.5 times as long as 2nd one. Maxillary palp composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.00 : 1.27 : 2.52; 3rd segment (Fig. 2A, B) of normal size, with small ellipsoidal sensory vesicle 0.19 times as long as 3rd segment. **Thorax.** Scutum dark brown, with whitish-gray pruinose (silvery iridescent when illuminated) pattern composed of anterior pair of spots on shoulders, and large transverse band covering posterior 2/5 of scutum, which is connected to anterior pair of spots by broad band along lateral margins; anterior pair of spots moderately separated in middle (thus middle 1/3 of scutum non-pruinose), and changeable in shape according to direction of light, e.g., appearing as subanterior pair of triangular or rhombic isolated spots when illuminated anteriorly and viewed dorsally; scutum densely covered with copper-colored (appearing golden-yellow when illuminated) fine short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum medium to dark brown, with dark brown long erect hairs. Postnotum dark brown, whitish-gray pruinose when viewed at

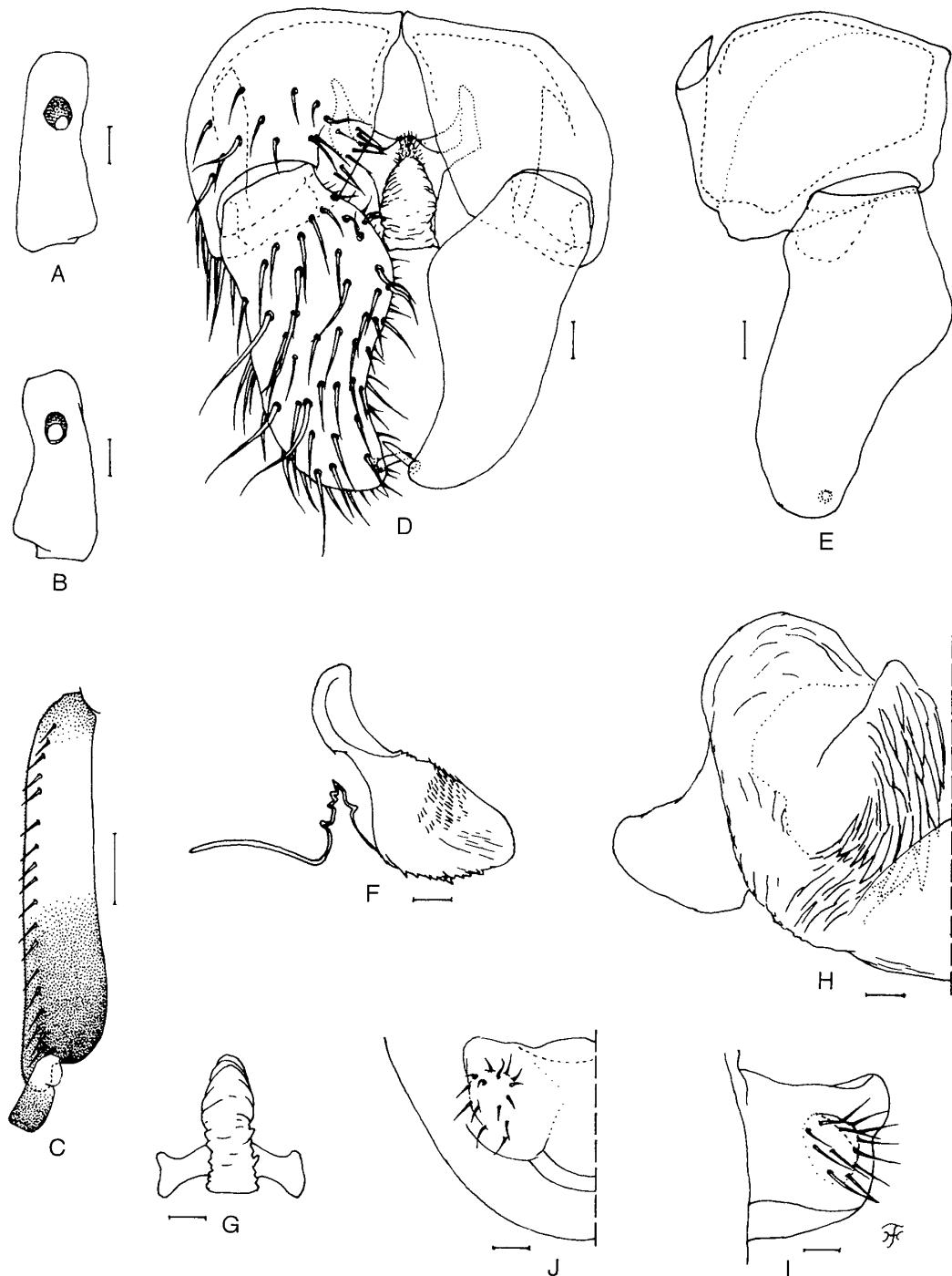


Fig. 2. Male of *Simulium (Simulium) banahauense* sp. nov. A and B, 3rd segments of maxillary palp with sensory vesicle (front view); C, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side, outer view); D, coxites, styles and ventral plate *in situ* (ventral view); E, coxite and style *in situ* (right side, ventrolateral view); F, ventral plate and median sclerite (lateral view); G, ventral plate (end view); H, paramere and aedeagal membrane (right half; end view); I and J, 10th abdominal segments and cerci (right side; I, lateral view; J, end view). Scale bars. 0.1 mm for C; 0.02 mm for A, B, D-G, I and J; 0.01 mm for H.

certain angle of light. Pleural membrane and katepisternum similar to those of female. **Legs.** Medium brown to brownish-black except fore coxa light to medium brown, basal 4/5 of mid basitarsus yellowish-white, bases of hind

femur and tibia light brown, a little more than basal 1/2 of hind basitarsus and basal 1/3 of hind 2nd tarsal segment yellowish-white; fore tibia with grayish shiny sheen on outer surface and mid tibia with similar sheen on posterior

surface when illuminated at certain angle of light. Fore tarsus with thick dorsal crest of short hairs; basitarsus greatly dilated, 5.1 times as long as its greatest width. Hind basitarsus (Fig. 2C) moderately enlarged, wedge-shaped, 4.47–4.56 times as long as its greatest width, 0.71 and 0.68–0.69 times as wide as greatest widths of hind tibia and femur, respectively; calcipala nearly as long as its basal width, and 0.36 times as wide as greatest width of basitarsus; pedisulcus distinct. **Wing.** Length 1.8–1.9 mm; other characters as in female except subcosta entirely bare. **Abdomen.** Basal scale brownish-black, with fringe of long hairs. Dorsal surface of abdomen medium brown to brownish-black, with dark hairs; segments 2 and 5–7 each with pair of silvery iridescent dorsolateral spots, broadly connected in middle on segment 2 but not on other segments; tergites of segments 8 and 9 shiny laterally though not silvery iridescent at certain angle of light. **Genitalia.** Coxite in ventral view (Fig. 2D) subquadrate. Style in ventral view (Fig. 2D) elongate, longer than coxite, widened from base to basal 1/3, then narrowed toward apex, with inner margin of apical 2/3 moderately concave, and with stout apical spine subapically; style in lateral view flattened ventrodorsally, without basal or subbasal protuberance; style in ventrolateral view (Fig. 2E) twice as long as greatest breadth at basal 1/3. Ventral plate in ventral view (Fig. 2D) with body nearly rectangular having ventrally-produced median process which is bare except parts of lateral and anterior surfaces covered with minute setae, and is furnished with several teeth in vertical row on each posterolateral margin; basal arms short, stout and diverged basally, then directed forwards; ventral plate in lateral view (Fig. 2F) with body and its ventrally-produced process with rounded ventral apex, with dentate posterior margin, and covered with minute setae anteromedially; ventral plate in end view (Fig. 2G) with body and ventrally-produced median process somewhat constricted medially, bare, with several teeth in vertical row on each lateral margin. Median sclerite in lateral view (Fig. 2F) moderately sclerotized, folded several times basally, and in posterior view plate-like, narrow basally, slightly widened toward apex. Paramere (Fig. 2H) very wide basally and with several parameral hooks apically. Aedeagal membrane in end view (Fig. 2H) weakly-

sclerotized and entirely bare. Ventral surface of 10th abdominal segment (2I, J) without any distinct hairs. Cercus (Fig. 2I, J) rounded, with 13–15 distinct hairs.

Pupa. Body length (excluding gill filaments) about 2.6 mm. **Head.** Integument (Fig. 3A) yellowish-brown, densely covered with round tubercles in neat order: frons with 2 simple short trichomes on each side, which are moderately separated from each other; face with 1 simple short trichome on each side, which is subequal in length to those of frons. **Thorax.** Integument yellowish-brown, moderately or densely covered with round tubercles and/or cone-shaped smaller tubercles; thorax with 2 simple slender medium-long trichomes mediadorsally, 2 similar trichomes anterolaterally, 1 similar but somewhat stouter trichome posterolaterally, and 3 simple trichomes (1 short and slender, 2 medium-long and somewhat stout) ventrolaterally on each side; 1 short stout spinous trichome ventral to base of gill filaments. Gill (Fig. 3B) with 6 slender thread-like filaments in pairs; dorsal and ventral pairs very short-stalked while middle pair almost sessile; all filaments subequal in length (0.8–1.0 mm long) and thickness; all filaments light yellow to yellowish-brown becoming lighter toward apex, gradually tapered toward apex; dorsalmost and ventralmost filaments diverged basally at right angle; cuticular surface with very distinct annular ridges and furrows throughout their length, covered with minute tubercles of different sizes, relatively larger ones on ridges and smaller ones on interridge spaces. **Abdomen.** Dorsally, segment 1 light yellowish-brown and segments 2–9 almost transparent; segment 1 moderately covered with minute tubercles on posterior 1/2, with 1 simple slender short hair-like seta on each side; segment 2 bare, with 1 simple slender short hair-like seta, 2 simple short setae and 3 simple stout spinous setae on each side; segments 3 and 4 each with 4 simple hooked spines and 1 simple short seta on each side; segments 5–7 bare; segment 8 with well developed spine-combs and comb-like groups of minute spines in transverse row on each side; segment 9 with comb-like groups of minute spines in transverse row on each side and without terminal hooks. Ventrally, all segments transparent; segment 4 with a few simple short setae on each side; segment 5 with pair of bifid hooks submedially and 1 simple

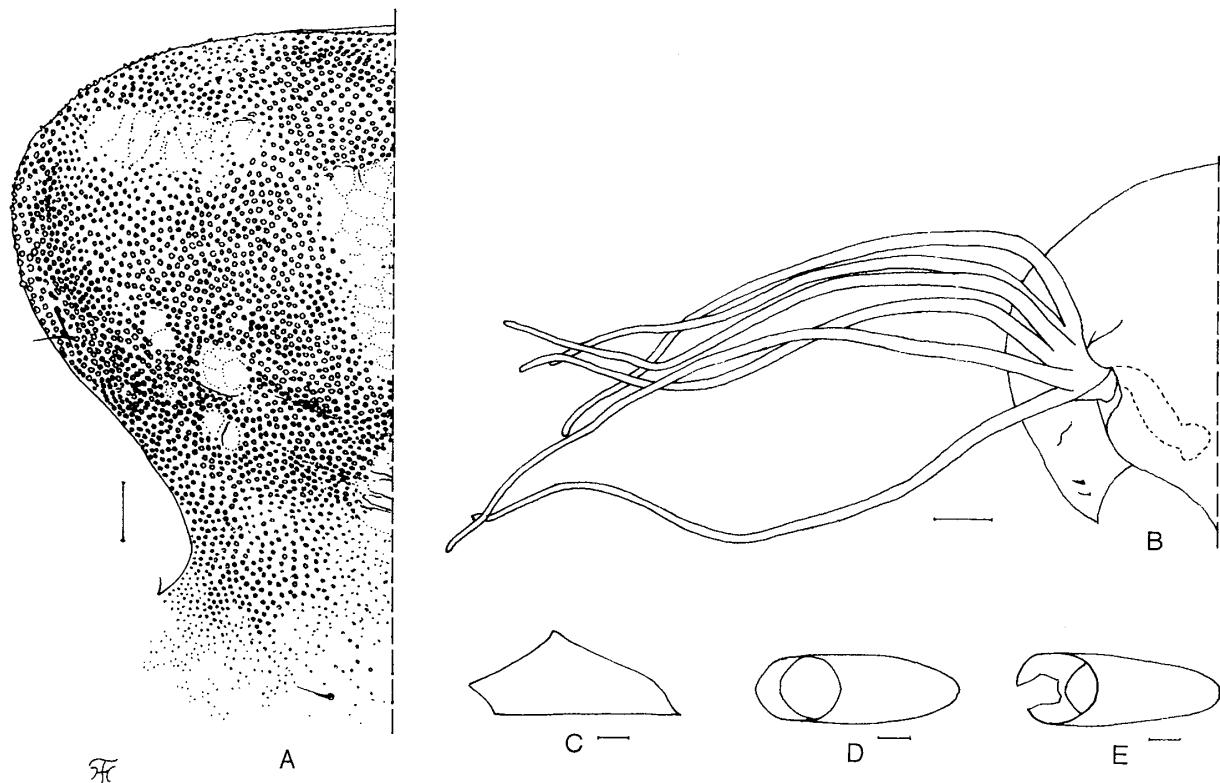


Fig. 3. Pupa of *Simulium (Simulium) banahauense* sp. nov. A, frons and upper part of face (right half); B, gill filaments (left side; outer view); C and D, cocoons with anteroventral collar completely woven (C, lateral view; D, dorsal view); E, cocoon with anteroventral collar incompletely woven (dorsal view). Scale bars. 0.5 mm for C-E; 0.1 mm for B; 0.05 mm for A.

short seta on each side; segments 6 and 7 each with pair of bifid inner and outer hooks widely spaced and 1 simple short seta on each side. Grapnel-like hooklets absent. **Cocoon** (Fig. 3C-E). Shoe-shaped, strongly woven, yellow to dark brown, not extending ventrolaterally; in 4 of 7 cocoons examined, median portion of anteroventral collar incompletely and irregularly woven, leaving narrow to wide and deep incision (e.g., Fig. 3E); 3.0–3.3 mm long by 1.2–1.3 mm wide; front collar 0.2–0.5 mm high.

Mature larva. Unknown.

TYPE SPECIMENS. Holotype female (with its associated pupal exuviae and cocoon), reared from a pupa collected from a tributary of Cristalino River at Banahau, Knabuhayan, Dolores, Quezon Province, Luzon Island, Philippines, 25. I. 2001, by H. Takaoka and A. Takaoka. Paratypes: 2 females and 3 males (all reared from pupae), same data and date as those of the holotype.

ECOLOGICAL NOTES. The pupae of this new species were collected from dead leaves in a moderately-flowing stream (width 6–10 m, water temperature 21.0°C, partially shaded, altitude about 600 m). Associated species were *Simulium (Gomphostibia) liliwense*, *S. (Wallacellum) cabrerai*, *S. (W.) recurvum*, *S. (W.) tuyense*, all described by Takaoka (1983).

ETYMOLOGY. The species name *banahauense* refers to the locality, Banahau, where this new species was collected.

REMARKS. *Simulium (S.) banahauense* sp. nov. is easily assigned to the *melanopus* species-group by the elongate paraproct and the elongate lobes of the eighth sternite fused to the ovipositor valves of the female genitalia (Fig. 1H), the pupal gill with six filaments (Fig. 3B) and the shoe-shaped cocoon (Fig. 3C–E).

This new species is remarkable in that

the aedeagal membrane of the male genitalia (Fig. 2H) is bare. The aedeagal membrane is covered with minute setae in all the known species of the *melanopus* species-group (except a few species, of which the male is not known yet). The female and male adults of this new species are also characterized by having the dark fore coxae. The majority of the 39 known species of this species-group have whitish or yellowish fore coxae, and only six species, i.e., *S. (S.) aquilum* Takaoka, *S. (S.) atrum* Delfinado, *S. (S.) conspicuum* Takaoka, *S. (S.) forcipatum* Delfinado, *S. (S.) subatrum* Takaoka, and *S. (S.) sumigorense* Takaoka, have the dark fore coxae (Takaoka, 1983, 2006a, b). However, the female and/or male genitalia of the latter six known species are completely different from those of this new species (Takaoka, 1983, 2006b).

Apart from these two characters, *S. (S.) banahauense* sp. nov. is very similar to *S. (S.) acostai* Takaoka described from Mindanao Island (Takaoka, 1983) in many features including the female and male genitalia, the number of the male large eye-facets, and the shape and relative size of the male hind basitarsus.

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